The Canadian Entomologist

LXIV ORILLIA, OCTOBER, 1932 No. 10

THE GEOGRAPHICAL RACE-CONCEPT IN LEPIDOPTERA

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In recent years there has been a growing tendency on the part of several eastern writers to place in synonymy races of our North American butterflies from widely separated localities.[1, 2] The attempt at simplifying our crowded check list is to be commended, but we do not see the advantage gained where such simplification is at the expense of the geographical race-concept.

The present trend is regarded by the writer as a step in the evolution of the science of taxonomy. With the exception of minor forms, the butterflies of the eastern half of the United States and southern Canada have been described for the last half century. The early stages are equally well known. Genitalic and other morphological comparisons have been made. Having exhausted these possibilities, eastern lepidopterists are completing the last bit of original taxonomic work possible in their territory: that of reducing the list to a permanent, workable basis,—an eventual status quo,—before turning to the next phase of study, that of ecology.

But is the West ready for this final effort? Has the preliminary work been done as thoroughly as in the East? First, a definition of the term West, as used in this article, would be in order. By West I do not mean Chicago. I refer rather to that great two-fifths of our continental territory from the Rocky Mountains to the Pacific. It is a world of three dimensions in which the miles stand on end as well as lying flat. It is a world which a dweller of the plains cannot appreciate until he has climbed a mountain at least ten thousand feet high. It is a world in which two miles, if they be vertical, affect the flora and fauna as remarkably as two thousand horizontal. And every mountain range and valley has its own peculiar race of *Argynnis, Brenthis, Euphydryas,* and *Melitaea.*

Western lepidopterists are now engaged in the work which occupied Scudder fifty years ago in New England. We have still a virgin territory over which to collect new races of butterflies, perhaps even new species. There are several isolated mountain ranges in California and Nevada which, because of their inaccessibility, have never been visited by an entomologist. Almost every trip into the desert of Southern California results in the solution of some life history problem. Mr. C. M. Dammers, within the space of two years, and within a radius of a hundred miles of his Riverside, Cal., home, has completed thirty-nine metamorphosis studies. Progressive collectors are amassing lengthy series of topotypical material in preparation for detailed genitalic studies, but such work

1 Holland, W. J. 1931. Annals of the Carnegie Museum, 2: 256. *Argynnis luski* B. & McD. is cited as a synonym of *irene* Bdv. The writer follows Dr. McDunnough in considering it a race of *eurynome* Edw. (Canadian Entomologist, LXIII, 10: 245).

2 Barnes, W. & Benjamin, F. H. 1926. List of the Diurnal Lepidoptera of Boreal America. Bull. Sou. Calif. Acad. Sci. 25: 3-27. *Melitaea cerrita* Wright is made synonymous with *alma* Stkr.

has scarcely begun.[3] How can we commence this elimination process until we have all the races described and before us in series?

Consider the effect upon collectors so engaged of the remarkable statement by Dr. Holland that *Argynnis luski* B. & McD., from Eastern Arizona, is identical with *Argynnis irene* Bdv., from the northern counties of California. Heretofore we had regarded them as extremes along two lines of development and were making field trips with the possibility of finding an interesting intermediate in Southern California or Western Arizona. To be told that our extremes are identical takes the zest out of collecting in the intervening territory and discourages work of the type the West most needs.[4] In ten years of collecting I have traveled 30,000 miles along the Western Cordilleras from Canada to Mexico. (In fact, West Coast experience includes Mexico, Nicaragua, and Panama, countries outside the scope of this article, but to which the geographical race-concept applies equally well.) My viewpoint is admittedly that of the field collector rather than that of the academic taxonomist to whom type locality means a place name on a label rather than a certain grassy meadow in the Sierra Nevada. It is to associate the insect more closely with the place of flight and to explain phenomena observed in the field that I have been obligated to adopt a conception of these races which differs essentially from that held by a majority of those now engaged in taxonomic revision.

The original description of an organism consists of two parts; first, a word picture of its structure, pattern, and coloring, (supplemented by later writers with a figure of a designated type); second, a notation as to the time and place of capture of the specimen. While it is impossible to pay too much attention to the first in making careful comparisons, it is possible to slight the latter or neglect it entirely, as seems to have become the custom. The geographical concept demands that an equal emphasis be placed upon type locality.

To illustrate: When Dr. J. A. Comstock described *Argynnis hydaspe viridicornis* he did two things; first, he described it as a butterfly differing from typical *hydaspe* by having lighter ground color on the inferior surface and consequently more conspicuous markings; second, he described it, as the name indicates, as that race of *hydaspe* which inhabits the Greenhorn Mountains, a spur of the Sierra Nevada which is its southermost extension. Recently I collected at the type locality, sending speciments East as *Argynnis viridicornis*. Regarding a specimen darker than the others a correspondent wrote, "I see no difference from typical *hydaspe*." The specimen, to his mind, violated the first section of the original description; therefore, its agreement with the second was of no consequence. His was a pure maculation-concept.

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3 Gunder, J. D. 1929. The genus *Euphydryas* Scud. of boreal America (*Lepidoptera, Nymphalidae*). Pan-Pac. Ent. 6: 1-8.

4 That western collectors are sincere in their efforts to solve this and other distributional problems by obtaining ample topotypical material on which to base decisions, rather than by comparing a single specimen of one with a picture of the other, is amply proven. Mr. F. W. Friday and Lloyd Martin returned from Gold Lake, Sierra Co., Cal., and Shasta, Siskiyou Co., Cal., respectively, with good catches of *Argynnis irene* Bdv. Dr. J. A. Comstock and Dean Schlobohm returned from the White Mts. of Ariz. with long series of *Argynnis eurynome luski* B. & McD. Through their courtesy I have examined over one hundred specimens and find not one in either series which could be confused with any specimen in the other.

Again this correspondent writes, "I have a specimen from Northern California which I have classified as *viridicornis.*" He disregards the fact that his specimen was collected *north* of the type locality of *hydaspe,* not *south.* Once more: "I am making genitalic slides of *Argynnis semiramis* Edw. from Santa Cruz, Calif.", a locality which is 400 miles north of the San Bernardino Mountains, stronghold of *semiramis* and northernmost point of its occurrence. Why, when topotypical material is abundantly available for the asking, does he prepare a slide from a specimen which looks to him like *semiramis* but which, from the locality, must be an atypical *californica* Skin. or *clemencei* Comst.? Again, he has purely a picture-book conception.

The geographical race-concept is based upon two fundamental principles: (1) butterflies may be segregated into two general groups, (a) those enjoying a continental or world-wide range (cosmopolites), (b) those of relatively restricted flight. (2) Species of mundane distribution are remarkably alike in widely separated regions; those of restricted distribution show constant variation in even closely adjacent localities. For species of the latter class it is possible to approximate a mathematical axiom: the butterfly varies directly as the topography of its habitat. Having agreed that variation exists, we must also agree that variation is greatest where distance is greatest, and vice versa. Therefore, a species which differs markedly at the northern and southern extremities of its range will differ to a lesser degree between any two intermediate points. We must admit this difference whether it is visible at a glance or not.

In view of the above facts, can we consistently relegate to synonymy races whose type localities are hundreds of miles apart? Have we the right to disregard the efforts of a contemporary or predecessor and place the name which he advanced after careful study in the same category with mis-spelled words, preoccupied names, and simultaneous discoveries of the same organism, just because our race-concept differs from his or because we do not have access to his material?[5] Synonymy means identity. Can we say that Maine equals Montana, or that California occupies the same latitude and longitude as Colorado? Not if we know the geography as well as taxonomy.

The western United States has two great mountain ranges to which all others are subsidiary. The Sierra Nevada begins in California and is continued in Oregon and Washington as the Cascade Range. The Rocky Mountains extend from Arizona and New Mexico (White Mts.) through Colorado, Wyoming, Idaho, and Montana. One great stem is characteristic of the Sierra-Cascade. It includes at least three species: *irene* Bdv., *zerene* Bdv., and *hydaspe* Bdv., the latter with its geographical races, *viridicornis* Comst., *purpurascens* Hy. Edw., *rhodope* Edw., *sakuntala* Skin., and *minor* McD. Another great stem extends through the Rockies: *eurynome* Edw., with its races *luski* B. & McD. and *clio* Edw. The *hydaspe* group becomes progressively darker towards the north; the *eurynome* group lightens, the under side of the secondaries tending to become

5 "Who guarantees that the new examiner of the type is abler than the original describer in this respect? I think it often happens that the "reviser" has degraded a number of species into synonyms because he did not see the distinctive marks which the original describer stated, and which are in reality present." Strand, Embrik 1929. Down with the Type Cult. Psyche 3: 229.

immaculate green in the Alaskan *opis* Edw.* There is no confusion between these groups where they mingle in British Columbia as *rhodope* and *clio;* why should they be confused in the southern extremity of their ranges as *irene* and *luski,* or even *viridicornis*[6] and *luski,* when separated by a thousand miles of desert? The best way to get this particular geographical race-concept is to drive for four days from Apache Co., Arizona, to Sierra Co., California. Failing this, a map might be consulted.

The first argument which I am called upon to answer is this: "If every mountain and valley has its own race, and if each is deserving of a name, will not our check list become a gazeteer?" The answer is, emphatically, *no.* There are only four directions from the type locality of the species in which race development may proceed; namely, north, south, east, and west. If the type locality is near the seacoast, one and perhaps two lines of development are impossible. Consider the case of *Brenthis myrina* Cram. The type locality (New York) lies near the Atlantic seaboard, precluding a due eastern extension. Nor does the insect fly much farther south.[7] Its western manifestation is race *nebraskensis* Holland. Northward, we have a race from Manitoba without a name; but for our purpose *tollandensis* B. & Benj. will serve, as its 10,000 ft. elevation in Colorado places it, to the student of life zones, at least a thousand miles north at near sea level. Dr. Holland's *terra novae* may be considered eastern or northeastern, as you prefer. These names are in use already. But should the *myrina* from Labrador or from Northwestern Territory be described, the use of the names *terra novae* and *tollandensis* might be discontinued in favor of the more remote race which, being on the extension of a direct line from the type locality of the species to that of the previously known race, would presumably carry the same variation to its limit. The older names would be preserved as *race intermediate* until they lapse into a state of innocuous desuetude. Ultimately, not more than three race names would be in use, the species name generally representing one limit of divergence.

"But he would add another symbol to our list." (*r. int.*) Already I hear this argument and am prepared to meet it. If this conception adds a symbol it can also take one away. What is *f. alt.* but a geographical race which some active entomologist discovered by climbing a mountain a few thousand feet instead of traveling a thousand miles northward? On the eastern slope of the Sierra Nevada a *Phyciodes* is taken which grades imperceptibly from *campestris* Behr to *montana* Behr, the collector climbing from 4,000 to 9,000 ft. Such a series might also be taken at intervals of one hundred miles from Southern California to Montana. Are not the two identical from a life zone standpoint? It is Lower Sonora, Upper Sonora, Transition, and Canadian either way. The argument has been advanced that, with only a few thousand feet between them, the races commingle to a greater extent than when separated by a thousand miles. Storms might blow the *f. alt.* far down the mountainside. The same thing might be said

**opis* Edw. is a British Columbian subspecies, not Alaskan; see Can. Ent. 1927. Vol. LIX., p. 155. Ed.

6 Barnes and Benjamin list *viridicornis* as a synonym of *irene.*

7 Richards does not list a single stray from N. Car. or Tenn. in his Distributional Studies on Southeastern Rhopalocera. Bull. Brooklyn Ent. Soc. XXVI., 5:234-255.

of wind-borne seeds; but the perfect stratification of plants is the greatest biological phenomenon of the western mountains. The presence of races which preserve their identity in spite of this proximity is proof that such a thing does not occur. And is not vertical distance a much greater barrier to the distribution of species than horizontal? Let us dispense with *f. alt.* at once.

Thus far we have been concerned only with concepts of sub-specific rank. What place has the "transition form" or aberration, a sub-sub-specific[8] concept, in our discussion? To begin with, I am certain that every taxonomist will second my contention that if our check list is to become more voluminous, it had better be "cluttered" with the names of valid races, of which there are hundreds, thousands, even millions of examples, than with the names of individual variants.[9] But in the transition form we find the potentialities of the geographical race. When a single specimen is described, no one knows its possibilities. It may be a new species, race, sexual form, or any one of a number of monstrosities. It is when a second is found like the first that we should be interested. *Glaucopsyche lygdamus australis sinepunctata* Comst. was described not from one, but from three specimens taken in Mint Canyon, Los Angeles Co., Calif., where it has not been found since, to my knowledge. In collecting in Snow Creek Canyon, Riverside Co., Calif., I observed that one-third of the *australis* were completely without spots beneath, while many more exhibited this tendency. Is it not reasonable to suppose that, further south, two-thirds, and finally all would be *sinepunctata?* Our transition form is really transitory and not a sport in this case.

Unsilvered examples of *Argynnis macaria* Edw. are such great rarities that *laurina* Wright was formerly regarded as an aberration by those who collected in the Tejon and Tehachapi ranges. My collecting in the Greenhorn Range, adjoining to the north, revealed the interesting fact that all *macaria* were the unsilvered *laurina*. Fortunately *laurina* is given race standing by Barnes and Benjamin. A little more evidence regarding *sinepunctata* as a race should elevate this transition form to sub-specific rating.

Melitaea alma Stkr. was described from specimens from Arizona and Utah. It has been traced as far West as Pyramid Lake, Nevada. In Southern California dark *wrightii* Edw. pales to *cerrita* Wright as it approaches the Mojave Desert. Not only does it pale to *cerrita;* it becomes, in the Cajon Pass region, San Bernardino Co., indistinguishable from Nevada *alma*. For this reason Barnes and Benjamin list *cerrita* as a synonym of *alma*. The field collector, however, realizes that 500 miles of desert separate Cajon Pass and Pyramid Lake,—500 miles without a record of the intergradation which would prove them to be the same specific organism. Consequently, he is unwilling to say that he finds *alma* in Southern California until he has traced it from Pyramid Lake across Death Valley. Two steps in this direction are records of Dr. Comstock from Randsberg, Kern Co., and my own from Big Pine, Inyo Co. A Mono Co. link will complete the chain; not until then can *alma* be truly claimed for California.

8 Richards, A. Glen, Jr., 1931. Sub-sub-specific Names in Lepidoptera. Ent. News 8: 213-216.

9 Dr. A. B. Klots believes that "scientific names should not be applied to any concept lower than subspecies." On the Naming of Individual Variants in Lepidoptera. Ent. News XLI, 298-302; 324-328.

It is a matter of great regret that early writers were lax in mentioning type localities, even in indicating types. Such generalities as "California" and "Rocky Mountains" were acceptable a century ago when Jean Pierre Lorquin arrived in San Francisco with the 49'ers. Fortunately Lorquin's travels may be traced with considerable accuracy; his collecting grounds give us an index to type localities. Occasionally locality was not given in the original description, yet Dr. McDunnough can say with certainty of *A. irene* "a species from the higher altitudes of northern and central California",[10] and Gunder goes so far as to say "Boisduval's type MUST have come from the region around Truckee or north through Sierra or Plumas Counties of California." (Capitals mine).[11] The best we can do in such a case is to find the place where a majority of the specimens taken compare favorably with the type. But suppose we had only a figure of *M. alma* without the type locality, "Arizona and Utah." Our California *cerrita* would fulfill the picture-book requirement and we would be a thousand miles wrong in selecting Cajon Pass as an arbitrary type locality.

Another problem is presented when two localities are given in the original description. *Argynnis purpurascens* was described by Hy. Edwards from The Dalles, Ore., and Siskiyou Co., Calif. Edwards did not have the geographical concept (he described it as *var.*) or he would have realized that the organism could not be the same in two localities separated by the width of a state. But are present writers exercising more judgment on this point? Only two years ago Dr. Klots described *Lycaena heteronea gravenotata* from no less than three localities in the Colorado Rockies.[12] And he has climbed our western mountains! Are we to have "sub-specific" concepts of type localities? Must we differentiate between holotype locality, allo-type locality, and para-type locality?

The last question appropriate for consideration has reached the writer several times from independent sources. "Are we to consider topotypical specimens the only authentic material in our collections? They are too difficult to obtain. We cannot be expected to climb every mountain peak in the west before writing a revision." For a display collection, anything which approximates the typical is acceptable; but for genitalic or any other revisional work, a series from the type locality is indispensable. The difficulty of procuring such material is not as great as one might think, provided that one has a wide correspondence. I have obtained topotypes for serious students even when the localities were in remote parts of the state. The easterner who comes west in search of type localities will scarcely spend more time than the westerner who comes east to see for himself the types of California butterflies that will never be returned to California except by an Act of God. Such a pilgrimage requires him to visit every important eastern city. And if he is a true westerner, he would rather climb a thousand feet of mountain than a thousand marble stairs. But with series from type localities he has his own types for study.

We congratulate our eastern brother-lepidopterists upon their splendid contributions to the science of entomology. Some day, when the cards are all before us, we will follow their lead and discard superfluous race names. But

10 Canadian Ent. LXIII, 10:245.
11 Bull. Sou. Cal. Acad. Sci. XXX, 2: 46.
12 Klots, A. B. 1930. Diurnal Lepidoptera from Wyoming and Colorado. Bull. Brooklyn Ent. Soc., 3: 147-170.

we are not quite ready for this step. While you are using radio's latest device, the remote control, for settling our taxonomic problems, we are still hallooing to one another "anything new on your side of the mountain?"

PROGNATHISM AND HYPOGNATHISM IN INSECTS

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It is generally admitted that the primitive position of the Arthropod mouth and its associated appendages is ventral, this position being evident in the early embryonic stages of all groups and retained in the adult stages of many forms, particularly among the Crustacea. It is by no means to be inferred from this, however, that this ventral position of the mouth is the primitive one in the Insecta as a class. Great variability exists among insects in the postembryonic stages in respect of this feature. The mouth and jaws are usually directed more or less forward and downward but vary from a wholly anterior position to a definitely ventral one, or they may even be directed posteriorly.

The forward or prognathous position and the downward or hypognathous position are both very common among insects of many orders and it is evident that the change from one position to another has taken place many times in the course of evolution. In a recent paper on the head capsule of certain insect orders Crampton ('32) calls attention to the difficulty of deciding which type of head was the original one in the Insecta, pointing out that both types, prognathous and hypognathous, occur in the Apterygota as well as the Pterygota. He notes that, even within the comparatively specialized order Coleoptera, the whole gamut of variations met with in the lower groups, such as those of the orthopteroid series, are repeated, but is not satisfied in ascribing these variations to convergence, preferring the view that insects with similar types of head capsule have acquired these forms owing to the inheritance of similar genetic factors which have remained latent or recessive in many of the species represented in their line of ancestry.

Crampton makes no mention whatever of any relation between the form of the head or the position of the jaws and the habits or the environment of the insects he discusses. A very brief consideration of this aspect of the question shows clearly that the position of the jaws and the general form of the head vary readily in correlation with the habits of the particular species, especially the feeding habits.

Prognathism is common among carnivorous insects which chase their prey and capture it with their mandibles, (Cicindelidae, Carabidae), insect larvae which burrow in hard substances by means of the mandibles, e. g., larvae of wood-boring beetles (Cerambycidae and Buprestidae) and in general, in forms that habitually rest upon broad surfaces and lurk in crevices. Such insects tend to be depressed in the general form of the body, including the head, and prognathism, as a rule, is associated with a depressed head capsule.

Hypognathism, on the other hand, is found in such carnivorous insects as await the approach of their prey and seize it with raptorial front legs (e. g., Mantidae) or other prehensile structures, such as the specially modified, extensible labium of dragonfly nymphs. It is also common in phytophagous insects,

such as leaf-eaters, and is frequently associated with a compressed or cylindrical form of body, such as is found in insects of perching habits, e. g., the grasshoppers (Locustidae, Tettigoniidae). The fact that the form of the head is adaptive is, however, most clearly indicated in those forms in which it changes during metamorphosis from one type to another, in accordance with change of habits. This is well illustrated in the cerambycid genus *Monochamus*, whose wood-boring larvae have flat prognathous heads while the adults, which feed on green bark, have elevated, hypognathous heads.

Are there, then, any grounds upon which one can base an opinion as to whether any particular type of head capsule is primitive to the Insecta as a whole, or to any of the primary sub-divisions of the class? We think there are; at least for the primitively winged insects (Pterygota) as represented by the orthopteroid orders. We believe that the earliest winged insects were prognathous and that prognathism had probably already appeared in their wingless ancestors, since these were almost certainly ground dwellers.

As already mentioned, prognathous and hypognathous heads are found in both the Apterygota and Pterygota. Figs. 1 and 2 are lateral views of two genera of Apterygota, viz. *Machilis* and *Ctenolepisma*, both members of the primitive order Thysanura. *Machilis* is hypognathous, *Ctenolepisma* prognathous. In both genera the antennae arise close to the mandibular bases and the compound eyes are separated from the latter by a very narrow space, i. e., there is practically no gena. In both, also, the head capsule, as compared with most mandibulate insects, is little developed behind the eyes.

Fig. 3 is a lateral view of the head of a termite (*Termopsis*), a prognathous form, typical of many of the orthopteroid groups. It resembles *Machilis* and *Ctenolepisma* in the position of the eyes and antennae near the mandibular articulations but differs in the great development of the tergal region of the head capsule behind the eyes. This is due to a difference in the adductor muscles of the mandibles. In both Thysanura and the orthopteroid orders tergal and sternal adductors of the mandibles are present, but, whereas in the Thysanura the sternal muscles (arising on the anterior arms of the tentorium) are the more important and the tergal muscles relatively small, in the orthopteroid groups the reverse is the case, the sternal muscles being small or even vestigial while the tergal muscles are ernormously developed, being larger than all the other muscles of the head taken together.

These tergal adductor muscles arise from the postocular region of the head capsule and the size of this region is proportional to the development of these muscles. Hence this part of the head capsule in the Thysanura is very small, while in the orthopteroids, which have powerful mandibles, it is greatly expanded. In the soldier castes of termites, which have huge mandibles, the head capsule is greatly prolonged to give the necessary area of attachment for the immense tergal muscles.

In the more primitive head capsules of this orthopteroid type the lengthening of the dorsal region is unaccompanied by an equivalent extension of the ventral region (postgenae), so that the occipital foramen is elongated and its plane changed from the perpendicular to an oblique one, inclined from below upwards and backwards (fig. 3). In order to preserve the horizontal position of

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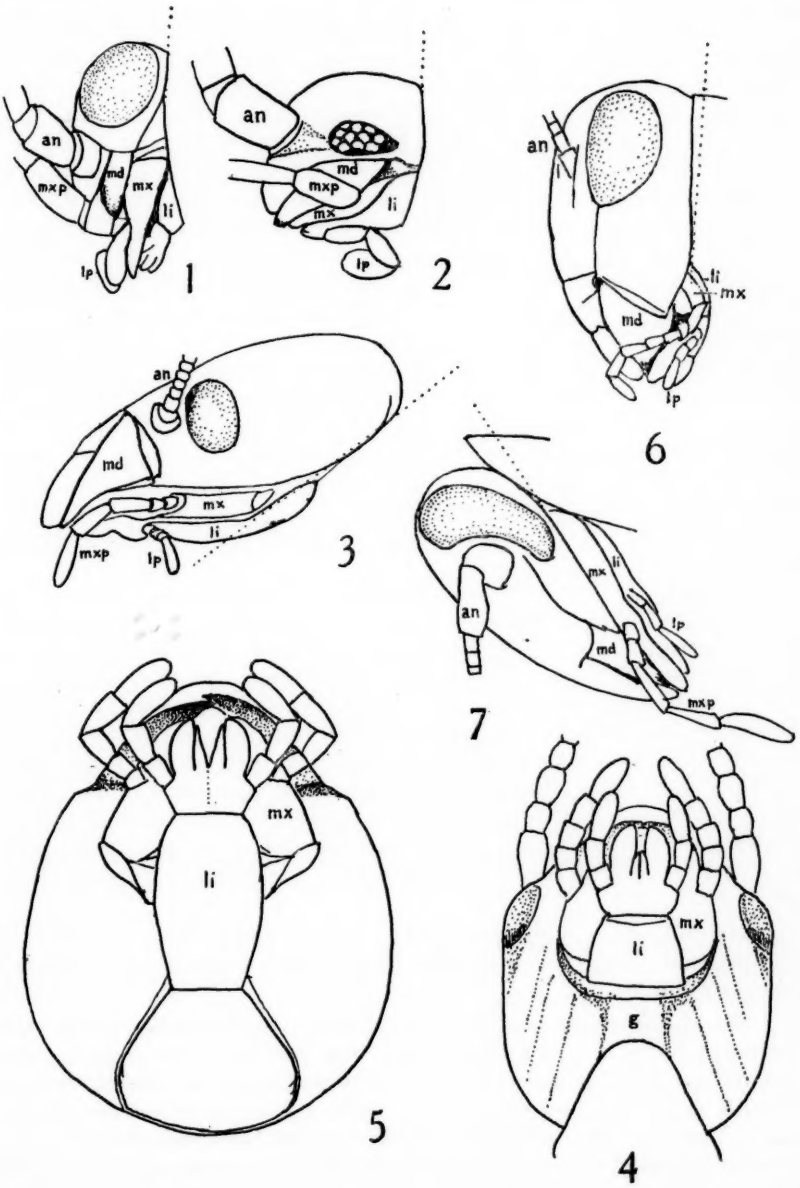

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the head, however, some compensatory ventral expansion must take place and this is effected in primitive forms by the cervical membrane, e. g., in the stick insect *Diapheromera femorata.*

In insects that live in a cool, humid environment in which evaporation from the body surface is slow, the cervical membrane, though expanded, may remain delicate and membranous. This is well exemplified by the primitive orthopteran *Grylloblatta,* whose general exoskeleton is rather thin, and which lives at high altitudes in the Canadian Rocky Mountains. In most forms, however, some further modifications have appeared to prevent an undue exposure of delicate membrane. In *Diapheromera* there is merely a thickening of the membrane, which, however, remains flexible. In other forms, such as the Dermaptera and Embioptera (fig. 4), a definite sclerite appears in the cervical membrane immediately posterior to the base of the labium, and in the latter order this plate becomes completely ankylosed with the adjacent margins of the postgenae (strictly speaking with postoccipital rim), i.e., the margins of what was originally the occipital foramen. This plate, generally known as the gula, is morphologically distinct from the true gula of the Coleoptera, though analogous in function. The true gula is formed from the hinder part of the submentum, which is posteriorly elongated and becomes divided during metamorphosis (Crampton, '21; Snodgrass, '28). The fact that the most primitive existing Coleoptera are prognathous and the gula is found throughout the order (except where it becomes reduced to a median gular suture) indicates that prognathism is the primitive condition in this order.

A similar prolongation of the submentum but without any separation of a gula is met with in the Isoptera (fig. 5), but in this group the elongation takes place in the region of the posterior tentorial pits, which are thus drawn out into slits, while in the Coleoptera it is usually behind though sometimes also in front of them, but the pits themselves are not elongated. In the soldier caste of the Isoptera this elongation of the submentum is extremely marked, being commensurate with that of the head capsule, and its margins become firmly united with those of the latter. In both the Coleoptera and the soldiers of Isoptera, as well as in other prognathous insects, such as the more specialized Plecoptera, the ventral elongation of the postgenae has kept pace with that of the dorsal region, and the occipital foramen thus retains, or has regained, its perpendicular plane.

Considering now the hypognathous type of head capsule as found among the orthopterois orders we may select as a typical example the grasshopper *Melanoplus* (fig. 6).

We may first note that this form differs from *Termopsis* and the other prognathous forms, as well as the hypognathous *Machilis* in the position of the compound eyes and antennal sockets in relation to the articulations of the mandibles (or to the epistomal suture which forms a brace between these articulations). There is a wide space between the antennal bases and this suture and the lower margins of the eyes are considerably above the mandibular articulations, so that a definite gena is present.

These and other differences to be noted seem to be most reasonably explained by regarding this type of head as a derivative of the prognathous

orthopteroid type. There has been an expansion of the frontal region without any corresponding development of ventral parts, and this has brought about a longitudinal curvature or bending of the epicranium, resulting in a downward rotation of the mouth parts and hence hypognathism. This expansion involves also the corresponding lateral areas, or genae, which, together with a narrowing of the interocular and interantennary areas, causes a compression of the head, its depth being greater than either its length or width. The postocular region is rather short but this is compensated for by the increase in depth, there being thus plenty of space for the attachment of the adductor muscles of the mandibles.

It will be noticed that the compound eyes reach the top of the head, permitting vision in the same directions as before, viz., upwards forwards and laterally. The antennae are likewise in the most favourable position, in front and close to the top of the head.

The occipital foramen is restored to its perpendicular position but by an entirely different process from that which occurs in the more specialized prognathous insects, i.e., merely by the rotation of the mouth parts from a horizontal or oblique to a vertical position.

In the Blattidae (fig. 7) and Mantidae hypognathism has developed without any compression of the head, which is quite as much flattened as in prognathous insects. There is, however, a similar longitudinal curvature with an expansion of the frontal region and to some extent of the gena* and the compound eyes, as in the grasshopper, reach the top of the head and are placed in the position of greatest advantage to the insect. The forward and downward rotation of the head in the Blattidae appears to be due to a forward thrust of the pronotum rather than to any marked change in the shape of the head itself.

The fact that, in the Blattidae, one of the most ancient of all insect families, the head is not prognathous, and that this is also true of practically all the saltatorial Orthoptera, might be offered as an objection to the view that the prognathous type of head in the Orthopteroid groups is the primitive one. This objection loses its weight, however, when we consider that the earliest fossil relatives of the cockroaches, the Protoblattoidea, were undoubtedly prognathous, as were also the fore-runners of the grasshoppers, the Protorthoptera. In all the other Orthopteroid groups of recent times the prognathous head with the antennae and eyes near the mandibles is the prevailing type, and in the most primitive representatives of these groups shows a close similarity of form and structure.

This view is further supported by the fact that, in the larvae of holometabolous insects (except such highly modified forms as the Cyclorraphous Diptera) the antennae and rudiments of the compound eyes are situated close to the bases of the mandibles, whatever position they may assume in the adult stage.

It should not be inferred from these observations, however, that hypognathism did not develop among the earliest groups of winged insects. As soon as the insect acquires the habit of seizing its prey during flight and of using its legs mainly for perching hypognathism appears to develop. We see it already among Carboniferous insects in the Megasecoptera and apparently even among the Palaeodictyoptera, and it is present in the extremely isolated but still existing

*In the Mantidae the gena is little developed owing to the huge size of the compound eyes.

orders Odonata and Ephemeroptera, to which it has been probably handed down from this remote period or, in any case, an extremely early one.

And we may finally emphasize the fact that prognathism, especially in the higher groups, is not necessarily a primitive feature. There is no reason why the hypognathous type of head should not revert to a prognathous one with change in habits of food and locomotion, although this change seems to have been less frequent than the converse one. Among the Saltatoria we have indications of it in such burrowing forms as the mole crickets (Gryllotalpidae) and the curious parallel group Cylindrochaetidae. The Gryllotalpidae are certainly modified crickets (Gryllidae) and, while the crickets are less hypognathous than most of the Saltatoria, being largely ground dwellers, the mole crickets possess a form of head that indicates a definite though incomplete return to the prognathous type.

SUMMARY

1. The position of the mouth and mouth-parts in mandibulate inserts varies greatly according to habits, especially those of feeding, locomotion and surface contact. Change from the prognathous to the hypognathous position may take place in the same individual during metamorphosis.

2. Both prognathism and hypognathism are met with in the Apterygota as well as the Pterygota.

3. In the Thysanura (representing Apterygota) the antennal sockets and compound eyes are near the mandibular articulations in both prognathous and hypognathous forms, and the head is little developed behind the compound eyes, owing to the small size of the tergal adductor muscles of the mandibles.

4. In prognathous orthopteroid insects (representing the primitive Pterygota) the antennal sockets and compound eyes are near the mandibular articulations but the tergal region of the head behind the eyes is expanded in order to accommodate the large tergal adductor muscles of the mandibles.

5. The elongation of the tergal region of the head is compensated for by various ventral modifications:—(a) In the most primitive condition the ventral region of the head itself is not affected but the cervical membrane is elongated; and the plane of the occipital foramen is changed from perpendicular to oblique. (b) Protection of the elongated cervical membrane may be afforded by the development of a guliform sclerite. (c) A similar function may be served by a backwardly elongated submentum, either undivided (Isoptera) or divided by a suture, the posterior separated plate being the gula (Coleoptera). (d) An elongation of the postgenae may take place, frequently in combination with (b) or (c), the occipital foramen regaining its perpendicular position.

6. The hypognathous type of head in orthopteroid insects differs from the prognathous type in the wider separation of the antennal bases and, to a greater or less extent, the compound eyes from the mandibular articulations. This is due to an expansion of the frontal and usually also the genal portion of the tergal region, which also causes a downward rotation of the mouth-parts and a restoration of the perpendicular plane of the occipital foramen.

7. The prognathous type of head in these groups is believed to be the primitive type for the following reasons:—

(a) The positions of the antennal sockets and compound eyes are comparable

to those of the Thysanura.

(b) It is the prevailing type in the orthopteroid groups.

(c) In those groups in which it is not characteristic of recent forms (Saltatoria, Blattidae and Mantidae) the fossil record indicates that it was prevalent among their forbears.

(d) In the larvae of holometabolous insects the positions of the antennae and rudiments of the compound eyes near the bases of the mandibles are indicative of a prognathous ancestry.

8. Hypognathism nevertheless appeared in some of the earliest groups of fossil insects (e. g., Megasecoptera) and its occurrence in the Odonata and Ephemeroptera is probably of extremely ancient origin.

9. Prognathism is not necessarily a primitive condition as found in recent insects. Hypognathous forms may revert to a prognathous condition with change of habits.

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EXPLANATION OF PLATE

The figures are semi-diagrammatic; the dotted lines indicate the plane of the occipital foramen; an, antenna; md, mandible; mx, maxilla; mxp, maxillary palpus; li, labium (submentum); lp, labial palpus; g, guliform sclerite.

Fig. 1. *Machilis*; left lateral view of head. Fig. 2. *Ctenolepisma*; left lateral view of head. Fig. 3. *Termopsis* (winged adult); left lateral view of head. Fig. 4. *Oligotoma*; left lateral view of head. Fig. 5. *Termopsis*; ventral view of head. Fig. 6. *Melanoplus*; left lateral view of head. Fig. 7. *Blattella*; left lateral view of head.

NOTES ON THE SYNONYMY OF CERTAIN EUXOA SPECIES WITH DESCRIPTIONS OF NEW SPECIES*

BY J. McDUNNOUGH,

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Euxoa plagigera Morr.

In working over our material in this group I have come to the conclusion that *olivalis* Grt. was incorrectly listed as a synonym of *plagigera* in the Barnes and McDunnough 1917 Check List.

The original description of *plagigera* (1874, Proc. Bost. Soc. N. H., XVII, 163) from a Colorado specimen is very brief and scarcely sufficient for identification; it was amplified by the author a year later (1875, Proc. Acad. N. Sci. Phil., 57) and specimens from Kansas and Illinois were mentioned. Both Smith and Hampson in their revisions treat the species as distinct from

*Contribution from the Division of Systematic Entomology, Entomological Branch, Dept. of Agric., Ottawa.

olivalis and Hampson's figure (Pl. LXI, fig. 30) is a recognizable one of the usually accepted idea of this species, although the color is somewhat too dark. Smith, who claims to have seen Morrison's type in the Tepper Collection, separates the species from *olivalis* on the strength of "the dirty whitish, not yellowish secondaries", whilst Hampson, with insufficient material before him, uses an uncertain character drawn from the thoracic banding for differentiation. Correspondence with Professor R. H. Pettit of the Michigan Agricultural College, Lansing, Mich., where the Tepper Collection is now housed, elicited the information that no type of *plagigera* Morr., so marked, is contained in this collection; he has very kindly furnished me, however, with photographs of two specimens which stand under this name, one, a female, unlabelled, and the other, a female, from Montana and these undoubtedly belong to the same species as defined by Smith and Hampson. As things are, with the actual type specimen apparently lost, there seems no reason for not accepting Smith's determination as correct.

The species is characterized by the bluish-gray tone of the primaries, the well-defined maculation, the long oblique orbicular with strong white edging, the almost entire lack of white scaling on the median vein below the orbicular and reniform, the well-defined white s. t. line, projected somewhat towards outer margin at veins 3 and 4 but not crossed by the white dentate marks on these veins and by the dirty-white, not yellowish color of secondaries, as stated by Smith. In the male genitalia the extension of the sacculus is longer on both sides than the harpe proper, but a slight asymmetry is shown, the left-side branch being quite distinctly longer and more curved apically than that of the right side.

Euxoa olivalis Grt.

The holotype of this species is a female from Idaho Spgs., Colo. (F. Snow), in the British Museum; it is figured by Hampson (Pl. LXI, fig. 29). I have a male specimen before me from Calgary, Alta. which has been compared with the type by Wolley-Dod and marked "very close", and have also examined, through the kindness of Professors Hungerford and Beamer of the University of Kansas, Lawrence, Kan. a topotypical specimen from the Snow Collection which was probably one of the original type specimens.

There seems no doubt but what this species is the same as the one recently described by Dr. W. C. Cook as *Euxoa macdunnoughi* (1930, Can. Ent., LXII, 147) and the name *olivalis* will have priority.

In a large number of cases the species may be distinguished from *plagigera* by the browner coloration of the primaries, the shorter orbicular, the less distinct maculation, especially the fainter t. p. line, and the obvious white shading on the median vein. Sometimes, however, (notably among Utah specimens) considerable blue-gray shading is found on the primaries, especially of the females, in which cases the white line along the median vein is often the best character. *Oblongistigma* Sm. is very easily confounded with *olivalis* at first, but the darker and more even brown color of the primaries and the practical lack of the s. t. line with a corresponding greater prominence of the dentate marks on veins 3 and 4 are characteristic; the hind wings, too, of the males are paler than in *olivalis* with a better defined marginal dark band.

In the male genitalia of *olivalis* the sacculus extensions are subequal, long, and curved at the tip around the end of the clasper; the harpe is smooth, about two-thirds the length of the lower projection and bowed outwardly. In *oblongistigma* the harpe is longer than in *olivalis,* being only slightly shorter than the ventral fork, and is covered with minute hairs.

The specimens listed by me as *oblongistigma* in my "List of the Lepidoptera of Seton Lake, B. C." (1927, Can. Ent., LIX, 194) all prove, on closer examination, to be *olivalis.* All three species occur also sparingly in the vicinity of Lethbridge, Alta.

A fourth species of the group, apparently unnamed, has been found amongst our Utah material. I describe it as follows:—

Euxoa melura n. sp.

Male. Head and palpi light brown; antennae serrate and fasciculate as in allied species; tegulae light wood-brown, crossed by a black line below which is whitish scaling, tips white; thorax light brown, sprinkled with black. Primaries light wood-brown, shaded with darker brown between the spots and subterminally. Maculation almost identical with that of *olivalis,* the t. a. line irregularly outwardly oblique, the t. p. line obsolescent; the reniform and orbicular neatly defined in white with a distinctly white median vein below them; claviform long, defined by black with a paler streak beyond it to t. p. line; s. t. line most characteristic for the species, broad, whitish, rather evenly parallel to outer margin and without any bulging at veins 3 and 4 as in *olivalis* and *plagigera,* with very strong blackish arrow-marks preceding it in subterminal space; veins 3 and 4 bordered with white as usual but not crossing the s. t. line; fringes smoky with pale basal line. Secondaries light smoky at base, deepening outwardly, rather more evenly dark than in the allied species.

In the genitalia (fig. 1) the sacculus extension is short, only about one-half the length of the harpe which at once distinguishes the species from all others in the group.

Female. Very similar to the male with neat, clean-cut maculation apart from the obsolescent t. p. line. Expanse 32-35 mm.

Holotype— ♂, Eureka, Utah, 19.VI.11 (T. Spalding), No. 3363 in the Canadian National Collection, Ottawa.

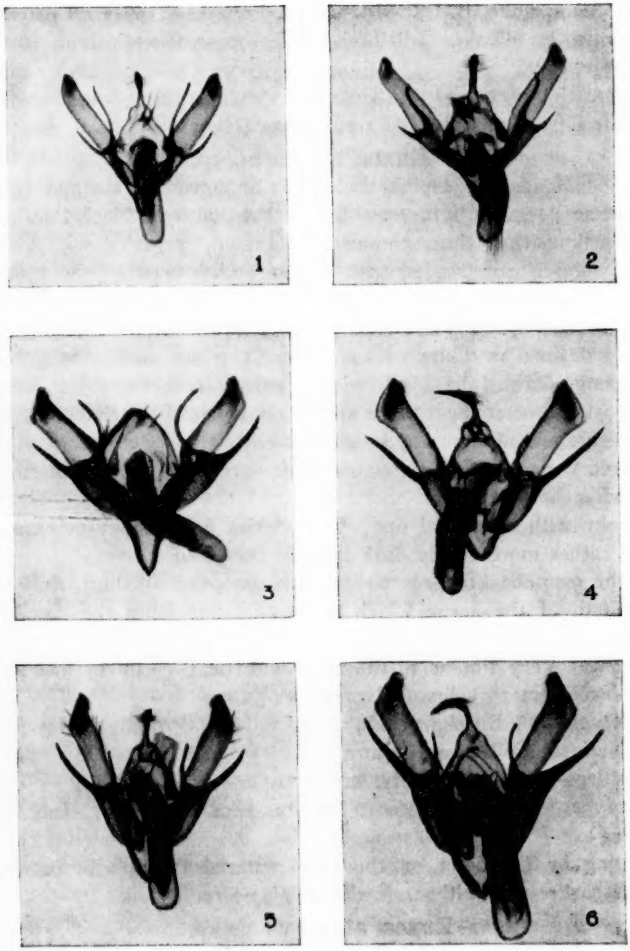
Allotype— ♀, same locality, 20.VI.11.

Paratypes—5 ♂, 4 ♀, same locality, June 19, 20, 21, July 6, 8, 1911, (T. Spalding).

Judging by the dates on the type material the species occurs at least three weeks earlier than either *olivalis* or *plagigera.*

Euxoa aberrans n. sp.

Male. Antennae very faintly serrate and fasciculate, almost ciliate, much as in *perolivalis* Sm. Palpi blackish outwardly, sprinkled with white scaling. Front largely deep smoky with traces of brown and white scaling; tegulae mixed brown and deep smoky with a few scattered white scales, the brown color predominating apically; patagia an admixture of deep smoky and white scaling overlying brown hairs. Primaries with a heavy suffusion of deep smoky, almost blackish, scaling over a basal brown color, this latter color only showing through in the median area; a quite noticeable sprinkling of white



Male genitalia of 1. *Euxoa melura* n. sp.; 2. *E. aberrans* n. sp.: 3. *E. scotogrammoides* n. sp.; 4. *E. pleuritica* Grt.; 5. *E. petruska* n. sp.; 6. *E. simona* n. sp.

scaling on top of this gives a decidedly hoary appearance. Maculation of the usual type but not very prominent; t. a. line dark, geminate, partly pale-filled, irregularly outwardly oblique; t. p. line rather obscure, dentate, well rounded opposite cell, inwardly oblique to inner margin; orbicular irregularly oval, slightly defined by a broken blackish line and filled with whitish scaling; reniform moderate in size, also with a blackish defining line which is partially bordered within by ochreous, the whole centre being filled by white scales on a smoky ground-color; claviform small, scarcely defined; median shade improminent, dark, angled at reniform; s. t. line white, irregular, defined on inner side by dark shading and outwardly, especially at costa, with white scaling. Fringes deep smoky. Secondaries deep smoky, paling in basal half; fringes whitish, cut by a smoky line near base, except at apex of wing where they are entirely smoky; a small dark discal dash. Beneath whitish, sprinkled with smoky, with the cell of the primaries and a broad terminal border of secondaries (not attaining apex) uniform smoky, a discal dash on each wing; fringes as above. Expanse 35 mm.

Holotype—♂, Jefferson Co., Mont., Aug. 3, 1927, (W. C. Cook); No. 3434 in the Canadian National Collection, Ottawa.

Paratypes—3 ♂, same locality, Aug. 8, 24, 28; 1 ♂, Lethbridge, Alta., July 11, 1904, (T. N. Willing) (ex Coll. Wolley-Dod).

The species is easily recognized on account of the practically simple antennae. I had at first considered that it might be *abnormis* Sm., but correspondence with Mr. F. H. Benjamin of the United States National Museum proves that it cannot be this. The type of genitalia (fig. 2) throws it into the *ridingsiana-perovalis* group where we already find a tendency to reduced serrations of the antennae, but the general appearance of the species is more that of a member of the *infausta* group. The small series before me, while agreeing in antennal and genital structures, shows considerable variation in the color and maculation of the primaries. One paratype from Montana agrees quite well with the holotype; the two other Montana paratypes are duller in color with little white scaling and have a more even smoky brown appearance; in one the maculation is quite well-defined, in the other very obscure except for the two spots. The Lethbridge specimen is the palest of the lot, being a dull ochreous, suffused terminally with smoky shading; it had evidently puzzled Wolley-Dod as it bears a label stating that a similar specimen sent to J. B. Smith was determined as either new or small, dark *pleuritica* Grt. Of course it cannot be this latter species as it differs in both antennal structure and genitalia; of the whereabouts of Smith's specimen I am ignorant.

Euxoa scotogrammoides n. sp.

Male. Antennae finely serrate and fasciculate. Head, thorax and primaries a powdery smoky brown with faint admixture of white scaling. Maculation indistinct (at times obsolescent), the whole insect having rather the appearance of a *Scotogramma* of the *oregonica* group. Primaries with ordinary lines indicated by dark spots on costa, t. a. line being the best defined, geminate and consisting of several weak scallops, slightly outwardly oblique from costa to cubital vein and then curved inward to inner margin; t. p. line scarcely visible; a rather broad but indistinct median shade, bent slightly inward at

costa; s. t. line pale ochreous, irregular and defined by a darker preceding shade. Orbicular faint, small, weakly defined by a light ochreous ring; reniform narrowly iunate, partly defined by pale ochreous, dark filled; claviform not indicated. A faint broken black marginal line. Fringes concolorous, with fine ochreous basal line. Secondaries smoky, paling in the basal half with strong discal lunule. Fringes pale smoky at base, whitish outwardly with a light ochreous basal line. Beneath dirty white, powdered lightly with smoky brown; cell of primaries largely smoky; faint traces of dotted postmedian line on secondaries; small discal lunules on all wings. Expanse 34 mm.

Female. Similar in maculation to male, but the secondaries are more evenly smoky brown, scarcely paling at all towards base. Expanse 36-38 mm.

Holotype—♂, Jefferson Co., Mont., June 27, 1928, (W. C. Cook); No. 3371 in the Canadian National Collection, Ottawa.

Allotype—♀, same data.

Paratypes—1 ♂, 3 ♀, Jefferson Co., Mont., June 27, July 3, 6; 1 ♂, 3 ♀, Hamilton, Mont., June 18, 21, July 17, (R. R. Parker).

The male genitalia, as a reference to the figure (fig. 3) will show, are very characteristic. I know of no species in which the harpe is so strongly bowed outwardly, the nearest in this respect being *serricornis* Sm. Some of the specimens show very little maculation, the dark shade before the s. t. line being apparently the most constant feature.

Euxoa pleuritica Grt.

The species was described from a male from "Canada" without further locality data. Dod (1911, Canadian Entomologist, XLIII, 361) states that Hampson figures the type under the name *insignata* Wlk. (Pl. LXIV, fig. 31) but the figured specimen is listed as from New York and can therefore hardly be the true type, although doubtless a correct representation of the species. In the east *pleuritica* appears to be rather rare but in Manitoba and Alberta it is not uncommon and specimens from this region often show considerable suffusion of light olive-ochreous on the primaries which together with the pale, round orbicular and the dirty white basal half of secondaries renders the species fairly readily distinguishable from *pestula* Sm. in which both primaries and secondaries are more evenly dark smoky; in *pestula*, also, the male antennae appear to be rather more strongly serrate and fasciculate. The male genitalia of the two species are very similar and the only point of difference I can note is that in *pestula* the harpe proper is somewhat longer than in *pleuritica*, being about three-quarters the length of the sacculus extension whereas in the latter species it is about one-half the length; this is most noticeable on the right side, the left side in both species being not quite symmetrical.

Two further undescribed species appear to be indicated in the group, very similar to *pleuritica* in general maculation and best differentiated on size and male genital characters.

Euxoa simona n. sp.

Male. Antennae distinctly more strongly serrate and fasciculate than in *pleuritica*. Coloration of primaries very similar to that of the darker and less contrasted specimens of *pleuritica*, being a light olive-brown with rather even sprinkling of smoky and pale scaling, the paler coloration predominant

in the lower half of the median and in the subterminal areas and the terminal area being largely dark smoky. Maculation of primaries as in *pleuritica.* Secondaries pale smoky basally with a slight pearly lustre, deeper smoky outwardly; a distinct dark discal streak, fringes white shaded with brown basally. Expanse considerably larger than *pleuritica*—44 mm.

Female. Similar to male in color and maculation.

Holotype—♂, Continental Divide, Yellowstone National Park, Wyo., July 23, (J. McDunnough); No. 3364 in the Canadian National Collection, Ottawa.

Allotype—♀, Head of Pine Creek, Calgary, Alta., July 5, 1896, (Wolley-Dod).

Paratypes—1 ♂, same data as allotype, June 27, 1896, (Wolley-Dod); 1 ♂, Broadwater Co., Mont., Aug. 25, 1927.

Superficially the species bears considerable resemblance to *Chorizagrotis auxiliaris montana* Cook but the characters of male antennae and genitalia throw it into the group under discussion. The similarity of genitalia (fig. 6) with *pleuritica* is very evident but the chitinization of the sacculus is heavier and on the right side the prong-like prolongation at the junction with the harpe is much broader; the whole prong is heavier and less pointed at the apex. The right harpe is longer than that of *pleuritica* and more as that of *pestula,* being about three-quarters the length of the lower fork. There is a slight assymetry between the right and left harpes, the left one being somewhat shorter; the length of the lower fork varies somewhat in individual specimens, in the Montana paratype being slightly longer than in the figured holotype.

Euxoa petruska n. sp.

Male. Antennae finely serrate and fasciculate, much as in *pleuritica;* palpi smoky with white sprinkling; head and thorax an admixture of smoky and whitish scaling with a slight sprinkling of brown; tegulae crossed by a black median line. Primaries a rather even light gray-brown, caused by sprinkling of white scaling on an olive-brown base; terminal area smoky. Maculation much as in *pleuritica,* very clean cut; basal one-half line geminate, blackish, pale-filled; t. a. line geminate, blackish, the outer line heavy and darker than inner one, slightly outwardly oblique and thrice roundedly dentate; t. p. line less distinct than t. a. line, geminate, the inner line most distinct of the two and slightly broken, well-rounded outwardly opposite cell and then inwardly oblique to inner margin at two-thirds; s. t. line distinct, whitish, with an irregular W-mark on veins 3 and 4. Claviform small, very faintly outlined in black; orbicular round, white, with central gray filling and a partial outer black edging; reniform similarly colored, much as in *pleuritica.* Terminal broken black line; dusky fringes. Secondaries pale smoky white deepening outwardly; fringes white with faint darker shade at base; small discal dot. Beneath as in *pleuritica.* Expanse much less than that of *pleuritica,* 32 mm.

Holotype—♂, Head of Pine Creek, Calgary, Alta., June 24, (Wolley-Dod); No. 3365 in the Canadian National Collection, Ottawa.

The species, apart from its small size, is more evenly gray in the coloration of the primaries than *pleuritica* with the black t. a. line and the pale spots standing out rather strikingly. The genitalia are essentially of the same type as in *pleuritica* but the sacculus extensions are relatively thicker and shorter;

a reference to the figure (fig. 5) will make this clear. The date of capture would indicate that the species flies earlier in the season than *pleuritica*.

A CORRECTION TO BRADLEY'S MANUAL OF THE GENERA OF BEETLES.

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On page 81, of the Manual, it will be noticed that the key to the genera of *Tachyporini* is somewhat confused. The alternate to the first series of characters refers us to number seven of the key. As there is no number seven, I have thought it advisable to publish the key in corrected form. It seems obvious that Bradley in re-arranging the key desired to follow Leconte and Horn's sequence of genera, viz. *Tachinus, Tachyporus, Leucoparyphus* (*Cilea*), *Physetoporus, Erchomus,* and *Conosoma*. To do this the key would of necessity contain two statements of characters lacking alternatives. As the "correct" sequence of genera (which by the way, differs from his attempted arrangement in the key—*Erchomus* preceding *Physetoporus* which in turn is followed by *Conosoma*) is given in the Taxonomic Conspectus, page 312, the necessity for such arrangement in the key is not evident. The following is the corrected table; no attempt has been made to follow the accepted taxonomic sequence of genera.

1. Abdomen margined; tibiae fimbriate at tip with unequal spinules.....(2)
   Abdomen not margined; tibiae fimbriate at tip with equal spinules..*Conosoma*
2. Mesosternum not carinate.....(3)
   Mesosternum carinate; maxillary palpi filiform.....(4)
3. Maxillary palpi filiform.....*Tachinus*
   Maxillary palpi subulate[1].....*Tachyporus*
4. Epipleura horizontal; elytra not prolonged.....(5)
   Epipleura vertical; elytra longer than body.....*Erchomus*
5. Mesosternum feebly carinate; anterior tarsi of the male simple..*Leucoparyphus*
   Mesosternum strongly carinate; anterior tarsi of the male dilated.....
   .....*Physetoporus*

1 Actually but the last joint of the maxillary palpi of *Tachyporus* is subulate.

NOTES ON SOME GALERUCINAE WITH DESCRIPTIONS OF NEW SPECIES (COL., CHRYSOMELIDAE)

BY CHAS. SCHAEFFER,
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Monoxia puncticollis Say.

Dr. Horn in his revision of the Galerucini* places *erosa, morosa* and *maritima* as plain synonyms with *puncticollis* with the remark that no tangible difference seems to exist. In this he is wrong for on comparing typical *puncticollis* from Colorado, N. Dakota, etc. with *maritima* from the Atlantic coast the differences are very obvious. The latter have the prothorax much less roughly sculptured, more smooth, the elytral punctures are larger and more densely placed and the elytral pubescence generally scarcely visible, at least more easily abraded than in the typical form. The California form—*morosa*—is very close to *maritima* which Dr. Leconte describes as differing from the latter by the explanate or

*Trans. Am. Ent. Soc. Phil. XX, 1839. p. 85.

flattened hind angles of pronotum and somewhat denser elytral pubescence; with this my single female from California agrees, but more specimens may show the variability of these characters; in *maritima* the hind angles are generally more or less flattened and somewhat explanate. The form *crosa* is described from Utah and has apparently a slightly more roughly sculptured pronotum than the typical form; this sculpturing, however, is variable in the latter, but the elytra are more finely punctate, especially apically. The color in the few specimens seen is as described by Dr. Leconte, dull yellow, and the hind angles of pronotum are scarcely flattened either in these or in typical *puncticollis*.

Monoxia puncticollis texana n. var.

Color above pale luteous, head usually with a narrow black median line; outer joints of antennae infuscate; elytra with well defined black vittae, one on each side near suture, starting at base near scutellum but not reaching the apex, the other near lateral margin, slightly longer than the one near suture; underside black except apex of ventral segments pale, last segment entirely pale, legs pale, femora at middle infumated.

Head rather closely cribrate; antennal joints narrower and less stout than in typical *puncticollis* and slightly more elongate. Pronotum less roughly scabrose than the latter and more like *maritima;* posterior angles more or less flattened. Elytra pubescent, closely punctate, but the punctures well separated and smaller than in *maritima*. Ventral segments finely and closely punctate and sparsely pubescent, the pubescence on mestasternum longer and denser. Length: 7 mm.

Brownsville, Texas.

The male differs scarcely from the female either in form or in the shape and size of antennal joints.

While specimens with clearly vittate elytra in the typical form or varieties are apparently rare, the variety *texana* is always clearly vittate, though the sutural vittae may be interrupted below the scutellum or, rarely, entirely absent, but the submarginal vittae are always present and entire. As usual it varies a little in size and also in coloration of the underside of which the ventral segments in one specimen are pale but the sides of each have a large, dark cloud; occasionally there is a narrow black line at middle of pronotum. The pale surface color showing the black elytral vittae very prominently, the rather narrower antennal joints, the elytral puncturation and sculpture of pronotum, separate *texana* from the typical form as well as from any of the varieties.

Phyllobrotica antennata n. sp.

Male: Form and coloration of *limbata* F. Antennae piceous, except the first joint, which is reddish yellow and strongly inflated; the last three or four joints somewhat flattened and broader than the preceding joints and the last three reddish. Pronotum rather feebly impressed near base. Elytra sparsely and finely punctate. First joint of tarsi longer than in *limbata*, posterior tibiae slender, slightly arcuate and not dilated internally. Fifth ventral segment at apex with a moderately deep and somewhat triangular depression at middle. Length: 6 mm.

Chestoa, Tennessee, June, (Siepman).

The males of this distinct species can be readily recognized from *limbata*, the only species with which it could be confused, by the rather strongly inflated

first joint of the antennae, which latter are longer and differently colored and by the last ventral segment with a less deep cupuliform impression. The female has longer antennae which are entirely black, longer tarsal joints, and the pronotum has no impressions. The only species of this genus with similarly formed and colored antennae is *sororia* but that species has the elytra colored as in *decorata* and the fifth ventral segment of the male is differently formed.

Phyllobrotica stenidea n. sp.

Male: Generally smaller in size than any other N. American species; head black, pale anteriorly; antennae generally pale; prothorax pale; scutellum more or less pale; elytra black with a very narrow pale sutural vitta, which is straight, not dilated below the scutellum and not extending around the latter; lateral margin narrowly pale, at apex wider and a more or less distinct, but very narrow pale vitta from humeral umbo to apex; below and legs pale except metasternum, which is black. Head smooth, shining; antennal joints rather short and gradually increasing in stoutness. Pronotum transverse, smooth and shining; sides very feebly narrowing from apex to base; hind angles distinct, anterior angles obtuse; surface with a more or less distinct broad, transverse impression. Elytra rather finely and sparsely punctate. Body beneath finely and sparsely punctate; last ventral segment larger than any of the preceding, with a large, deep, cupuliform impression which is broadly lobed at middle at apex but not notched each side and from the base of the last segment to about the middle of the cupuliform impression is a somewhat geminate median costa. Length: 4 mm.

Female: Slightly larger; the antennal joints narrower, slightly longer and more or less black as is also the underside except the legs, and the narrow, pale median vitta of each elytron is mostly faintly indicated or entirely absent.

New Jersey, Pennsylvania, Dist. Columbia.

A specimen from New York, a female, has the head entirely pale but agrees in everything else with the specimens which have the head bicolored.

This species is apparently closely related to *vittata* Horn but besides the generally smaller size and different elytral coloration the female of *vittata,* the only sex of that species known to me, has relatively longer and slightly narrower antennal joints than *stenidea* with the third joint nearly equal in size to the fourth—in the latter species the fourth joint is distinctly longer than the third.

The two specimens, male and female, having a narrow, short, elytral vitta, mentioned by Dr. Horn in his remarks following the description of *vittata* may belong here.

Luperodes lecontei asclepiadis n. var.

Form, size, coloration of upper surface and sculpture of pronotum and elytra as in typical *lecontei,* but the five or six outer antennal joints, also the femora and hind tibiae are in great part black.

Copper Mt. Brit. Col., (G. Stace Smith), on *Asclepias speciosa.*

Paratypes in the collection of Mr. Smith.

The coloration of the legs and antennae varies a little, especially in the females of which in some specimens the anterior femora are entirely pale and the outer antennal joints are scarcely black apically.

Monolepta crucigera Schffr.

Luperodes marginalis Fall, 1910, Trans. Am. Ent. Soc. XXXVI, 149.

Mr. Fall described *Luperodes marginalis* from specimens collected at Alpine, Texas, and from the same locality I have also specimens before me. However, as they have the anterior coxal cavities closed, they do not belong in *Luperodes* but in *Monolepta* and are the same as my *M. crucigera*.

This species is very variable in regard to the markings of the elytra, in some they are very distinct in others faint or entirely lost. I had at first mounted a few of the better marked specimens from which the description had been made, however, I had others among unmounted material without or with faint markings. In one of my Texas specimens the transverse elytral fascia is indicated.

A MOTH SEIZED BY A BIRD AND REJECTED UNHARMED (LEPID.: ARCTIIDAE.)

BY HAROLD O'BYRNE.

Webster Groves, Missouri.

The recent publication by McAtee* on protective adaptations should stimulate field observations on warning coloration, mimicry, and kindred phenomena. The incident described below should be of interest because of its bearing upon this subject.

On July 6, 1932, I observed a female of *Diacrisia virginica* Fab. resting on an inside wall of a large building in St. Louis, Missouri, where it probably had alighted the night before. At 6:35 p. m. (Central Standard Time) it suddenly took flight, passing out of the building through a wide doorway. An English sparrow nearby saw the moth and started in pursuit; the moth flew to the ground, but resumed flight when the bird alighted beside it. The sparrow followed the moth and caught it in the air with its beak. It carried the moth to the ground some thirty feet away and dropped it there. Then the bird gave it an investigating peck or two, and then stopped. After standing guard over the moth for a few minutes, and then chasing away another sparrow that approached, the bird presently flew away itself. I picked up the moth, which began to struggle for freedom, and I saw that it was uninjured except for a badly torn hind wing. When I placed it in a small box, ovipositing began at once; more than 500 eggs were laid, which subsequently hatched.

Contrary to the opinion often expressed by proponents as well as adversaries of the various theories on protective adaptations, this occurrence shows that attacks by birds upon insects, even when they are as soft and delicate as this moth, need not necessarily be fatal. It shows, too, that birds may have ample opportunity to discover any disagreeable quality that may make an insect an unsatisfactory morsel of food, without seriously injuring it. Whether this particular species is so protected I do not know, but the action of the sparrow in catching the moth and then deserting it appears significant.

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*McAtee, W. L. Effectiveness in nature of the so-called protective adaptations in the animal kingdom, chiefly as illustrated by the food habits of nearctic birds. Smithson. Misc. Coll., vol. 85, No. 7, March 15, 1932.

A NEW APHODIUS FROM CALIFORNIA

BY R. E. BARRETT,
Saticoy, California.

Aphodius tuberosus n. sp.

Oblong, convex, shining black. Head convex without trace of tubercles, closely punctate; clypeus feebly emarginate, the angles broadly rounded, genae moderately prominent, antennae black. Pronotum one and one-half times as wide as long, side margins not explanate, hind angles distinct but obtuse, base feebly arcuate, basal marginal line entire and distinct, disk evenly convex, puncturation rather coarse and dense less so on vertex. Scutellum small. Elytra at base not quite as wide as thorax, wider behind, humeri distinct with an acute tubercle, striae moderately deep rather coarsely punctate, intervals flat except posterior quarter where they are definitely convex, puncturation fine and sparse. Mesosternum not carinate between the coxae. Metasternum coarsely evenly punctate. Abdomen indistinctly punctate. Anterior tibiae smooth in front, tridentate externally, not crenate above the upper external tooth, first tarsal segment longer than the second. Middle and posterior femora coarsely densely punctate. Posterior tibia with unequal spinules, first tarsal segment as long as the next four combined. Length, 4.0 to 5.0 mm.; breadth, 1.2 to 1.8 mm.

Holotype and numerous paratypes in my own collection.

All were taken by me during March and April, 1932, from nests of the wood rat, *Neotoma*, in Rose Valley of Sespe Canyon, Ventura County, California.

By Horn's Monograph this species runs to *terminalis* and *cruentatus* in Group I-d as does *vandykei* which was also described from *Neotoma* nests. It may readily be separated from these species by its uniform shining black color, acute tubercles on the humeri, lack of tubercles on the head and the anterior tibiae not being crenate above the upper external tooth.

ANNUAL MEETING ENTOMOLOGICAL SOCIETY OF ONTARIO

The sixty-ninth Annual Meeting of the Entomological Society of Ontario will be held at the Entomological Branch, Department of Agriculture, Confederation Building, Ottawa, on Thursday and Friday, December 1st and 2nd, 1932, and if the program is sufficiently full to warrant it the meeting will be continued on Saturday, December 3rd.

The evening lecture will be held in the Auditorium of the National Museum.

All those interested are urged to make every possible effort to be present in order that the previous success in our society meetings may be continued. The presentation of papers and active part in discussions is desired.

Titles of papers to be presented should be in the hands of the society Secretary by November 15th. Please advise time for reading and whether lantern is needed.

Dr. W. H. Brittain, President, Macdonald College, Que.

R. H. Ozburn, Secretary, O. A. College, Guelph.

Local Committee—Ottawa: Messrs. W. N. Keenan, C. R. Twinn and S. H. Short.

Mailed Saturday, Oct. 29, 1932.